UNDERGROUND INJECTION CONTROL PERMIT APPLICATION: HILMAR CHEESE COMPANY

PORTION OF SECTION 10, T6S/R10E, MDB&M
MERCED COUNTY, CALIFORNIA

September 17, 2004

Prepared by:
San Joaquin Energy Consultants, Inc.
Bakersfield, California

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UNDERGROUND INJECTION CONTROL PERMIT APPLICATION:

HILMAR CHEESE COMPANY

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UNDERGROUND INJECTION CONTROL PERMIT APPLICATION:
HILMAR CHEESE COMPANY

1. GENERAL INVENTORY INFORMATION

   A. Facility name, address, telephone:

   Hilmar Cheese Company
   9001 North Lander Avenue
   P. O. Box 910
   Hilmar, California 95324
   Telephone: (209) 667-6076
   FAX: (209) 634-1408

   B. Property owner(s) name(s), address(es), telephone(s), including both surface and mineral rights owners):

   <u>Surface Owner</u>

   Hilmar Cheese Company
   9001 North Lander Avenue
   P. O. Box 910
   Hilmar, California 95324
   Telephone: (209) 667-6076
   FAX: (209) 634-1408

   <u>Mineral Rights Owners</u>

   Hilmar Cheese Company
   9001 North Lander Avenue
   P. O. Box 910
   Hilmar, California 95324
   Telephone: (209) 667-6076
   FAX: (209) 634-1408

   See Supplement A of this permit application for a complete list of mineral rights owners.

   C. Operator/legal contact name, address, and telephone number of person responsible for facilities who can be contacted by Board staff:

   OPERATOR:
   Hilmar Cheese Company
   9001 North Lander Avenue
   P. O. Box 910
   Hilmar, California 95324
   Telephone: (209) 667-6076
   FAX: (209) 634-1408

   CONTACT:
   Mr. Warren Climo
   Director, Environmental Management
   9001 North Lander Avenue
   P. O. Box 910
   Hilmar, California 95324
   Telephone: (209) 656-2294 (Direct Line)
   FAX: (209) 656-1184

D. Project type (cogeneration, refinery, industrial treatment, commercial disposal, etc.):

Industrial waste treatment process for dairy factory.

E. Operating status of other well(s) on site:

Wells within 0.5 mile of the proposed injection wells are shown on maps included in Attachment 1 through Attachment 3.

2. DATA: WELLS WITHIN AREA OF REVIEW

Volumetric and pressure front calculations indicate that the area of influence for this project is a 1,371-ft radius around each proposed injector, with no dispersion, and a 1,518-ft radius with dispersion. The area of review for this project was a 2,640-ft radius, or a 0.5-mile radius, around each injector (Attachment 1). Additional discussion of area of influence calculations is provided in Section 8 of this permit application.

Attachment 3 includes a location map of the wells, summary table of well data, well owner information, and, if available, well construction data, histories, and logs for wells within the area of review. Oil and gas well data are available to the public and included in Attachment 3. Information on water wells and other privately-owned wells is confidential and available only if authorized for release by their owners.

A. Legal contact(s) (names and addresses):

Hilmar Cheese Company
9001 North Lander Avenue
P. O. Box 910
Hilmar, California 95324
Telephone: (209) 667-6076
FAX: (209) 634-1408

All legal contact information for other wells is included in Attachment 3.

B. Well name(s) and approximate location(s) (section, township, range):

See Attachment 1 through Attachment 3 for well location maps and information. All wells are located in the Mount Diablo Base and Meridian (MDB&M).

C. Date(s) drilled (plus dates of significant workovers, abandonment date, etc.):

Attachment 3 includes complete well histories for the oil and gas wells and any available information for other types of wells.

D. Well depth(s):

Information on well depths is included in Attachment 3.

E. Type of well(s) (hydrocarbon production, injection, dry, irrigation, domestic water supply, geothermal, etc.):

Wells within the area of influence include abandoned oil and gas exploration wells, industrial water wells, irrigation wells, groundwater monitoring wells, and domestic water wells. Well types are included in the well summary table in Attachment 3, which also has well data sorted by type.

F. Status (active, inactive, plugged, abandoned, etc.):

All oil and gas wells within the area of influence have been abandoned. Methods of abandonment are provided in Attachment 3 for the oil and gas wells. If known, information on the status of other wells within the area of influence is included in Attachment 3.

G. Construction information (cement, casing, tubing, completion, and plugging records. Include "as built" diagram of each well showing construction, tops of injection and confining zones and formation tops):

See Attachment 3 for construction information on wells within the area of influence.

H. Perforated and/or screened interval(s):

See Attachment 3 for detailed well information.

I. Distance(s) from injection well(s):

Distances of wells in the area from the proposed injection wells are shown on Attachment 1 through Attachment 3.

J. Annotated copies of all lithologic, wire-line and geophysical logs, mechanical integrity tests, etc.:

See Attachment 3 for annotated well logs for the petroleum exploration wells in the area. Annotated formation tops also are included in Table 3B in Attachment 3, on geologic cross-sections, and on the type log for the area, as discussed in Sections 4 and 5 of this permit application.

K. Well history:

Complete well histories are included for all petroleum exploration wells within the area of influence in Attachment 3. Where available, well histories for other wells types also are provided in this attachment.

L. Contingency plan for well failures:

Three wells will be used as the primary injectors, with one well available as a back-up injector during routine well maintenance and repairs. Treated wastewater can be diverted to the back-up injector up to its maximum allowable rate and pressure. It also is planned to have an area of land that will have Regional Water Quality Control Board (RWQCB) permits to discharge wastewater directly onto in small quantities. These permits are being worked on concurrently with this permit process.

Depending on the type of well failure, e.g., casing split, cement bond breakdown, etc., appropriate action will be taken to continue injection service within the applicable permit requirements. In the event of tubing or packer leaks, injection will be suspended until the appropriate section of tubing or packer can be replaced. For pump failure, the pump, motor, or associated electrical system

components will be replaced or repaired. If the injection well is unable to be returned to service, abandonment of the failed well and drilling a new injector will be done in accordance with applicable regulations and after approval by appropriate regulatory agencies.

M. Corrective/remedial action for improperly abandoned well(s):

None anticipated. All petroleum wells within the area of influence have been abandoned in accordance with DOGGR regulations. Abandonment approvals are included with well histories in Attachment 3. Other wells in the area were completed about 2,800 ft above the proposed confining zone and would not affect or be affected by proposed injection operations.

N. Contingency plan for surface spills or equipment failure:

The company has two 20 million-gallon clay-lined ponds on the site. These are sufficient to contain up to 20 days of treated wastewater in the event of equipment failure. Also, depending on the type of failure, appropriate action will be taken to continue injection service according to UIC permit conditions. If only one well fails, the wastewater can be diverted to the other disposal wells up to their maximum permitted rates and pressures.

3. REGIONAL GEOLOGY

A. Regional structural geology:

The Hilmar site is located in the northern San Joaquin Valley within the Great Valley Geomorphic Province. The structure of the Great Valley is an elongate, relatively undeformed lowland basin surrounded by highly deformed rock units of the Coast Ranges to the west and the Sierra Nevada to the east (Norris and Webb, 1990). The Hilmar project area lies about 40 miles southeast of the Stockton Arch fault zone. Regional dip in the area is to the southwest.

B. Regional stratigraphy:

The general stratigraphy of the northeastern San Joaquin Basin in the Hilmar area is shown in a fence diagram[1] (Attachment 4A). A block diagram of the shallow subsurface, showing the relationships of shallow groundwater systems in the area, is also included in Attachment 4B.

The stratigraphy near the site is typical of the northern San Joaquin Valley. Recent to Pleistocene, non-marine sediments are present at the surface and to a depth of about 550 feet. Below this depth, the Pliocene and Miocene section includes sands and shales of the Laguna, Mehrten, and Valley Springs formations, which extend to a depth of about 3,100 feet. The lower 1,000 feet of this section appears to be a regressive sequence of Miocene to upper Oligocene age, grading from marine shales at the base to sands at the top. This sequence is in angular unconformable contact with underlying Eocene rocks.

The Eocene section includes the transgressive marine Kreyenhagen Formation and grades upward into shelf sands and silts. The Kreyenhagen shale occurs at a depth of about 3,200 feet. It is one of the most areally extensive and well-known formations in California and will act as the confining zone for proposed injection operations.

Underlying the Kreyenhagen shale, there is a 700-foot thick section of marine shelf sands and silts ranging in age from Paleocene to Cretaceous. This section includes the Domengine sandstone, the Tesla Formation, and the Moreno Formation. The proposed injection zone is in these Paleo-Cretaceous sands, which rest on the regionally extensive Hall shale of Cretaceous age. The Hall shale would act as an additional zone of confinement below the proposed injection zone.

Beneath the Hall shale are the thick Garzas sands of Upper Cretaceous Moreno Formation, which occur at a depth of about 4,100 feet. These sands and various other Cretaceous marine rocks, including the Panoche Formation, extend to a depth of about 12,000 feet, where basement rocks consisting of green quartzite and volcaniclastic lithologies are encountered.

A type log that includes the general stratigraphy of the project area is shown in Attachment 5.

[1] Several, connected geologic cross-sections that show the relationship of geologic units in a given area.

C. Seismic activity:

The site is located about 20 miles northeast of the Ortigalita–Telsa fault zones. These faults are recognized by the State of California as active and are subject to disclosure under the Alquist-Priolo Act. East of the site, the nearest active faults recognized by the State of California are on the eastern side of the Sierra Nevada.

Based on the California Geological Survey's database of earthquakes from years 1769 to 2000 of magnitude 4 or greater, the nearest earthquake epicenter is located 17 miles south southeast of the site and is listed as a magnitude 4.1 event (http://www.consrv.ca.gov/CGS/rghm/quakes/index.htm).

The California Uniform Building Code (UBC, Section 2312) defines the area where the Hilmar Cheese Company facility is located as Seismic Zone 3.

4. HYDROGEOLOGY OF CONFINING ZONE FOR PROPOSED WELLS

Regional Hydrogeology: **The project area is located within the Turlock Subbasin of San Joaquin Valley Groundwater Basin (Calif. Dept. of Water Resources, 2004). The Turlock Subbasin lies east of the San Joaquin River, west of the crystalline rock of the Sierra Nevada, and between the Tuolumne and Merced Rivers.**

The main hydrogeologic units in the subbasin are divided into unconsolidated and consolidated sedimentary deposits (Attachment 4). From youngest to oldest units, the unconsolidated deposits consist of:

- **Flood-basin deposits**
- **Younger alluvium**
- **Older alluvium**
- **Lacustrine and marsh deposits**
- **Continental deposits**

In the Hilmar area, the lacustrine or marsh deposits form a shallow groundwater barrier referred to as the E-Clay aquitard, which appears to be correlative with the Corcoran clay in the San Joaquin Valley (Calif. Dept. of Water Resources, 2004). The E-Clay forms the base of the unconfined aquifer in the project area and confines the

underlying aquifer in the continental deposits (Attachment 4B; Brown and Caldwell, 2004; Nolte and Associates, 1995). The E-Clay aquitard locally occurs at a depth of about 180 to 190 ft, is about 60 to 80 ft thick (Attachment 6), and dips to the west-southwest (Nolte and Associates, 1995).

According to Page and Balding (1973), the deeper, consolidated deposits include the following three main water-bearing units:

- **Pliocene to Miocene Mehrten Formation**
- **Miocene Valley Springs Formation**
- **Eocene Ione Formation, which is not present in the Hilmar area.**

Within the Eocene section, the Kreyenhagen Formation is a marine shale that overlies the proposed injection zone and will act as the confining zone. Detailed discussion of the Kreyenhagen Formation is provided in this section.

A. Formation:

The shale of the Kreyenhagen Formation is the principal confining zone for proposed injection operations.

B. Age of confining zone:

The Kreyenhagen Formation is of middle to late Eocene in age and was deposited between 40 and 50 million years before present (MYBP).

C. Thickness of confining zone:

The Kreyenhagen shale is about 100 feet thick at the site. Variations in thickness are shown on the isochore map of the confining zone (Attachment 7).

D. Mineralogy and lithology of confining zone:

Regionally, the Kreyenhagen Formation is a dark gray to brown massive shale that may contain significant silica from radiolaria, diatoms, and sponge spicules. Pyrite is commonly described, and glauconite is a common and distinctive component that occurs near the base of the shale. South of the site, the Kreyenhagen thickens

to more than 900 feet and is considered a petroleum source rock because the shale contains a high percentage of organic carbon.

Locally, the Kreyenhagen shale is described as a pale yellowish-green to green claystone and green to brown shale (based on ditch samples in the Emerald-San Joaquin Corporation "Hillman-Genzoli Gas Unit" well No. 1, located in section 4, T6S/R10E). The claystone is massive with common pyrite, various mafic minerals, and glauconite. Portions of the claystone appear to be tuffaceous. The shale is massive, soft, smooth to finely gritty, becoming silty in part, with abundant mica.

E. Structure of confining zone (faults and extent, fractures):

The structure on top of the Kreyenhagen shale (Attachment 8) suggests the formation has undergone mild to moderate deformation. Mapping has not indicated any significant faulting in the area. Page and Balding (1973) also found that, although faulting has occurred in the basement complex, it has not influenced the general movement of groundwater in the area.

F. Stratigraphy of confining zone:

The regionally extensive Kreyenhagen shale was deposited as a result of a rapid sea level rise that flooded much of California during the middle Eocene. This eustatic sea level event submerged the shelf and moved the shoreline eastward. At the type locality on Canoas Creek in the Temblor Range of Fresno County, von Estorff (1930) describes it as:

> **"...generally characterized as an organic shale, with a few lenses of fine-grained sandstone and limestone. Only one mollusk, Pecten interradiatus, was found in the shale. Foraminifera are ordinarily scarce and poorly preserved; and only a scanty fauna was obtained from the base of the formation. Radiolaria are plentiful throughout..."**

In other outcrops, diatoms are plentiful (Milam and Ingle, 1982).

In the subsurface, the Kreyenhagen shale is characterized by excellent electric log markers that can be correlated over hundreds of square miles. This suggests the deposition occurred in a low-energy environment that was cut off from an influx

of coarse clastics. In the project area, the abbreviated section of the Kreyenhagen is probably the result this area being near the basin margin in the middle Eocene.

G. Description of vertical and lateral continuity of confining zone within a minimum one-mile radius of the proposed injection well):

The Kreyenhagen Formation appears to be areally extensive, with good continuity both laterally and vertically. The vertical continuity of the confining zone is demonstrated by a map of Kreyenhagen thickness (Attachment 7) and in geologic cross-sections through the area (Attachment 9). A structure map of the Kreyenhagen Formation shows that the confining zone extends well beyond the minimum one-mile radius from the injection wells (Attachment 8).

H. Hydrogeologic parameters of the confining zone:

1. Hydraulic conductivity or permeability (horizontal and vertical):

   The Kreyenhagen shale exhibits a "baseline" shale response on the spontaneous potential (SP) log because of positive millivolt deflection by saline formations in low-salinity drilling fluids (Attachment 5). This characteristic is consistent with rocks having negligible porosity and permeability and generally considered as evidence that they are impermeable. Also, at the Moffat Ranch gas field, located about 45 miles southeast of site, there are thin, gas-charged sands within the Kreyenhagen shale, which demonstrates a hydraulic conductivity low enough to confine even gaseous substances over geologic time.

   Core data from the Kreyenhagen shale confining zone in the area of review were unavailable. However, permeability of the confining zone was estimated to be 1 millidarcy (md) based on intrinsic permeabilities for clay, silt, sandy silts, and clayey sands given in Fetter (1994, p. 98). The estimated hydraulic conductivity in the Kreyenhagen shale is 1.08×10^{-06} cm/s, or 3.06×10^{-03} ft/d.

2. Porosity:

   Core data from the Kreyenhagen Formation in the area of review were unavailable. However, porosity of the confining zone was estimated to be 27% based on a porosity comparable to that in the proposed injection zone, as

discussed in Section 5.H.2 of this permit application (Pacific Geotechnical Associates, 2004a).

3. Compressibility:

Compressibility of the confining zone is estimated to be 3.4 x 10^{-6} psi^{-1} based on compressibility values for consolidated sandstones with porosity of 26% at a lithostatic pressure of 0.75 psi/ft (Craft and Hawkins, 1959).

5. HYDROGEOLOGY OF INJECTION ZONE FOR PROPOSED WELLS

<u>Regional Hydrogeology:</u> As discussed in the introduction for Section 4 of this permit application, the principal hydrogeologic units in the Turlock Subbasin of the San Joaquin Valley Groundwater Basin are divided into unconsolidated and consolidated sedimentary deposits (Attachment 4B). From shallow to deep zones, the unconsolidated deposits have unconfined, semi-confined, and confined aquifers (Dept. of Water Resources, 2004; Brown and Caldwell, 2004). In the Hilmar area, the consolidated deposits have confined aquifers in the Pliocene-Miocene Mehrten Formation and the Miocene Valley Springs Formation (Page and Balding, 1973). Except for the Mehrten Formation, the consolidated deposits generally produce only small quantities of groundwater to wells (Dept. of Water Resources, 2004). The proposed injection zone for the Hilmar project is in the undifferentiated Paleocene-Cretaceous sands, which are part of a deeper, confined aquifer system, as discussed in this section and Section 6 of this permit application.

A. Formation:

Paleocene and Upper Cretaceous sands below the Kreyenhagen shale and above the Upper Cretaceous Hall shale are the zones proposed for injection operations. The undifferentiated Paleo-Cretaceous sands include the Domengine sandstone, the Tesla Formation, and the Moreno Formation.

B. Age of injection zone:

The sands are considered to be late Cretaceous to Paleocene in age.

C. Thickness of injection zone:

The gross interval proposed for injection is about 700 feet thick in the project area. Annotated well logs and geologic cross-sections show the gross thickness of the injection interval in the area of review (Attachment 3; Attachment 9). The net sand in this interval is between 500 and 600 feet (Attachment 10). The Paleocene-Cretaceous sands in the proposed injection zone in the nearest well to the site, the Atlantic "Hilmar" well No. 1, have a gross thickness of about 700 ft and a net sand thickness of about 520 ft.

D. Mineralogy and lithology of injection zone:

Based on ditch samples in the Emerald San Joaquin Corporation "Hillman-Genzoli Gas Unit" well No. 1, located in section 4, T6S/ R10E, the proposed injection zone is predominantly a fine- to medium-grained quartz-rich sand. Sand grains are subrounded to subangular and poorly to moderately well-sorted. Biotite, muscovite, lignite, and various mafic minerals can compose from 5% to 50% of the rock. The upper sands commonly contain chlorite and traces of volcanic fragments.

E. Structure of injection zone (faults and extent, fractures):

The local structure in the project area consists of a gentle southwesterly-dipping homocline (Attachment 11). The structure on top of the Paleocene-Cretaceous sands suggests the formation has undergone mild to moderate deformation. However, mapping does not indicate any significant faults in the proposed injection zone within the area of review. Page and Balding (1973) also concluded that, although faulting has occurred in the basement complex, it has not influenced the general movement of groundwater in the area.

F. Stratigraphy of injection zone:

The Paleo-Cretaceous injection zone sands are interpreted to be marine deposits from an inner shelf sand environment (Attachment 5).

G. Description of vertical and lateral continuity of injection zone within a minimum one-mile radius of the proposed injection well:

Vertical and lateral sand continuity of the Paleocene-Cretaceous sands within a one-mile radius of the proposed injection wells is good to excellent in the lower portion of the proposed injection zone and fair to good in the upper portion. The vertical continuity of sands in the proposed injection zone is shown on the isochore map of the Paleo-Cretaceous sands (Attachment 10) and on geologic cross-sections through the area (Attachment 9). The lateral continuity of the sands in the injection zone extends beyond the minimum one-mile radius of the proposed injection wells (Attachment 11).

H. Hydrogeologic parameters of injection zone

1. Hydraulic conductivity or permeability (horizontal and vertical):

   The permeability of the Paleocene-Cretaceous sands in the proposed injection zone is estimated to be 500 md based on permeabilities in late Cretaceous producing zones in surrounding fields (Calif. Dept. of Conservation, 1998; Calif. Dept. of Conservation, 1981). The hydraulic conductivity of the proposed injection zone is estimated to be 0.00054 cm/s, or 1.53 ft/d.

2. Porosity:

   Porosity is estimated to be 27% based on sonic log porosity calculations from nearby well "Gonsalves well No. 1" in section 22, T6S, R10E, which determined to porosity in this zone to be 29% (Pacific Geotechnical Associates, 2004a).

3. Reservoir pressure:

   Currently unknown, but estimated to be ~1,507 psia @ 3,350' based on an assumed regional reservoir pressure gradient of 0.45 psi/ft established by reservoir pressure measurements in surrounding fields, as provided in *California Oil and Gas Fields* (Dept. of Conservation, 1998) and summarized in the table below.

Field	Psia	Depth	Pisa/ft	Field Location
Vernalis	**1,765**	**3,800**	**0.46**	**28 miles NW of Hilmar site**
Chowchilla	**1,513**	**3,350**	**0.45**	**31 miles SE of Hilmar site**
Mint Road	**2,837**	**6,450**	**0.44**	**30 miles SE of Hilmar site**

4. Storage coefficient:

Using a minimum injection zone thickness of 500 ft, the storage coefficient, S, of the proposed injection zone is 0.00091.

$$S = (27\%) * (0.433 \text{ psi/ft}) * (500 \text{ ft}) * [(3 \times 10^{-6}) + (3.4 \times 10^{-6}) / (27\%)] = 0.00091$$

5. Compressibility:

Compressibility of the confining zone is estimated to be 3.4×10^{-6} psi^{-1} based on compressibility values for consolidated sandstones with porosity of 26% at a lithostatic pressure of 0.75 psi/ft (Craft and Hawkins, 1959).

6. Transmissivity:

Using a minimum injection zone thickness of 500 ft:

Estimated transmissivity = 1.53 ft/d * 500 ft = 765 ft^2/d = 5,721 gal/d/ft

7. Formation fracture pressure:

Formation fracture pressure is estimated to be ~2,680 psia @ 3,350', based on a fracture pressure gradient of 0.80 psia/ft. Surface injection fracture pressure, neglecting friction pressure, is estimated at ~1,206 psia.

8. Depth of injection zone:

Average injection zone depth is approximately 3,350 ft to 4,150 ft for all injection wells proposed for this project.

9. Proposed perforation or screen interval (depth) within the injection zone:

   Proposed perforated interval is approximately 3,350 ft to 4,150 ft for all proposed injection wells (Attachment 12).

6. FORMATION WATER

   A. Total Dissolved Solids (TDS):

   Analyses of formation water in the proposed injection zone are not available either through on-site sampling, well file review, or literature search. However, based on analysis of the spontaneous potential (SP) curve on the well log for the Atlantic "Hilmar" 1 well in section 10, T6S/R20E, and equations described in WELENCO (1995), formation water quality of 10,000 mg/l TDS or more was calculated by Pacific Geotechnical Associates (2004b). The calculated TDS of the formation water in the proposed injection zone also is shown on the type log for the project area (Attachment 5).

   B. Analysis of representative formation water sample to include trace elements and priority pollutants (EPA methods 624, 625, and metals):

   Analyses of formation water from the Paleo-Cretaceous sands in the proposed injection zone were not available through public sources or literature search. According to Page and Balding (1973), the Cretaceous marine sandstones and shales in the proposed injection zone should not be considered as potential aquifers because they are reported to yield only saline water to wells. Samples of formation water from the injection zone will be collected and analyzed when the first injection well is drilled.

   C. Description of sampling and analytical procedures:

   Representative samples will be collected using standard quality assurance/quality control (QA/QC) procedures in accordance with EPA SW-846 methodology. A third-party, California-certified laboratory will be used to analyze the samples within the allowable holding times using EPA-approved methods. Detailed procedures for sampling and analyses are described in Attachment 13.

D. Direction and rate of regional groundwater flow:

As previously discussed in Sections 4 and 5 of this permit application and shown schematically in Attachment 4, groundwater in the Turlock Subbasin occurs as:

1) An unconfined aquifer in the unconsolidated deposits;

2) A semi-confined aquifer below the unconfined aquifer and overlying the E-Clay or Corcoran clay-equivalent;

3) A confined aquifer beneath the E-Clay in the unconsolidated deposits; and

4) Confined aquifers in the consolidated rocks

(Dept. of Water Resources, 2004; Brown and Caldwell, 2004; Page and Balding, 1973).

The general groundwater flow in the Turlock Subbasin is toward the southwest along the regional dip of basement rocks and sedimentary strata (Dept. of Water Resources, 2004). In the unconfined aquifer, regional flow typically is westerly to southwesterly and toward the major rivers (Page and Balding, 1973). Regional maps of the unconfined aquifer, showing a southwesterly groundwater flow direction, are included in Attachment 14. At the Hilmar site, groundwater in the unconfined aquifer occurs at depths from about 5 to 15 ft and flows radially away from a groundwater mound that occurs beneath a wastewater application area (Attachment 15; Brown and Caldwell, 2004).

Groundwater flow in deeper aquifers at the site has not been determined because of lack of data. Only one of the Hilmar Cheese Company monitoring wells, MW-19, is screened below the unconfined aquifer. MW-19, screened between depths of 50 and 60 ft, may be completed beneath a local clay lens that acts as a semi-confined aquifer. No other groundwater maps or head data from the deeper aquifers could be located. However, groundwater flow in the injection zone is assumed to occur along the southwesterly structural trend shown on the structure map of the Paleocene-Cretaceous sands (Attachment 8).

E. Direction and rate of injected fluid migration:

In the proposed injection zone, the minimum rate of injectate migration was determined by assuming the injectate would migrate radially away from the proposed injection wells. Based on waste front calculations over a 30-year period

(Attachment 16), the average rate of injectate migration, with dispersion, was calculated using the following formula:

Average migration rate = (Distance of waste-front)/(time)

No. of Years	Distance (ft)	Average Rate (ft/yr)
1	313	313
5	654	131
10	903	90
20	1,252	63
30	1,518	51

F. TDS (salinity) profiles:

TDS profiles in the proposed injection zone are shown on the type log for the project area (Attachment 5) and on the geologic cross-sections (Attachment 9).

G. Specific gravity or density:

The density of a sample of formation water in the proposed injection zone will be provided after a sample is collected during drilling the first well.

H. Temperature and pH:

Temperature within the proposed injection zone is estimated to range from 128°F to 142°F based on an average annual surface temperature of 61.8°F for the Hilmar area (www.worldclimate.com, 2004) and a geothermal gradient of 2°F/100 ft. A temperature gradient graph based on a plot of bottom-hole temperatures in nearby wells indicates a range of 110° F to 120°F (Attachment 17; Pacific Geotechnical Associates, 2004b).

The pH of the formation water in the proposed injection zone will be provided after a sample is collected during drilling the first well.

7. INJECTION FLUID CHARACTERISTICS

A. Narrative description of individual waste streams:

The wastewater streams to be injected are as follows:

Primary source: Advanced tertiary treated industrial wastewater from the dairy-processing factory. The organic components in the wastewater and some of the minerals are removed through physico-chemical dissolved air flotation, an anaerobic digester, and aerobic polishers. Residual minerals remain in the wastewater and will be injected into the proposed injection wells.

Additional process wastewater:

Water softener brine, spent acid cleaners, and boiler blow-down.

B. Mix ratio (average, maximum, daily):

Estimated mix ratios of the various waste streams are summarized in the following table. Peak loads are assumed to occur during the winter, rainy season.

Waste Stream	Operational Process	Daily Average (gpd)	Daily Peak (gpd)
Primary source:	Treated wastewater	2.0 MM	2.2 MM
Secondary sources:	Water softener brine	110 to 275	5,000
	Spent acid	3,000 to 5,000	
	Boiler blow-down	(Included in the total treated wastewater volume)	
Total waste		**2.003 MM to2.005 MM**	**2.205 MM**

gpd = gallons per day
MM = million

C. Constituent analyses to include trace elements and priority pollutants for individual and final waste stream(s) (EPA methods 624, 625 and metals):

The composition of the current waste stream, including analyses of the water softener brine, is included in Attachment 18. TDS will be in the range of about 1,000 mg/l to 3,850 mg/l prior to injection. The range is anticipated because of variable amounts of the secondary sources, such as brine and spent acid cleaning

chemicals, which will be available on any given day. It should be noted that this TDS range does not yet include the effect of adding TDS from the water softener brines and spent acid cleaners. These are being retested, and analyses will be provided later.

D. Detailed description of sampling and analytical methods, including quality assurance/quality control (QA/QC) procedures:

Injectate will be analyzed according to procedures in the Hilmar Cheese Company Sampling and Analysis Plan (Attachment 13). The Sampling and Analysis Plan provides uniform procedures to collect, handle, and analyze injectate samples. Discussion of QA/QC procedures to ensure that samples and analytical results are representative of the waste stream and the reporting requirements also are included in the Plan.

A 24-hour composite sample of the injectate will be collected once per month and analyzed according to standardized testing procedures as shown in Attachment 13, which is the current weekly testing regime for discharge waters. Samples will be collected using a refrigerated flow proportional sampler and prepared for collection by a certified third-party testing laboratory. Appropriate chain-of-custody procedures and forms will be used along with "in-house" log sheets.

A daily flow total and pressure log will be recorded from a continuous flow meter and pressure sensor. These meters will be tested and calibrated annually by a certified/qualified third-party flow verification company.

The compositional, flow, and pressure data will be summarized on a monthly basis and forwarded to the EPA as part of the facility's quarterly monitoring reports.

E. Temperature, pH, radiological characteristics:

The temperature of the wastewater stream normally will be in the range of 80° to 110°F range. The pH is expected to range between 6 and 8. The wastewater is not expected to demonstrate any radiological characteristics from this operation.

F. Compatibility of waste stream with receiving formation:

Although incompatibility of injectate and receiving groundwater is not anticipated, a compatibility analysis will be done.

G. Density:

The density of the discharge is expected to be 1.0 to 1.1 g/cm^3. The range is expected because of variability in the concentration of minerals and the addition rate of the secondary sources.

8. AREA OF REVIEW

A. One-half mile radius or area of influence, based on stratigraphy, whichever is greater:

The 0.5-mile area of review is greater than the area of influence, which was calculated to be about 1,518 ft, including dispersion. See Attachment 2 for the area of influence map and Attachment 16 for area of influence calculations.

B. Zone of endangering influence over design life expectancy of well for both the pressure front and the waste front:

1. Volumetric method:

Waste front radius at 30 years = 1,371 ft without dispersion.
Waste front radius at 30 years = 1,518 ft with dispersion.

See Attachment 16 for calculations. Please note that the waste front radii have been calculated using a conservative porosity of 25%. It was assumed that four injection wells would dispose of 12,000 barrels (bbls) per day.

2. Pressure build-up method (e.g., modified Theis equation):

Pressure increase at 30 years and radius of 1,500 ft = 34.09 psia (= 7.9 ft of head). See Attachment 16 for pressure front calculations.

C. Calculation of dispersion or migration through the confining layer:

Negligible at injection pressure.

D. Modeling (if applicable, including model documentation):

Not applicable.

E. Narrative description, calculation, and list of assumptions for each method:

Waste front calculations in Attachment 16 used methods described in Warner and Lehr (1981; pp. 107-114). Pressure increases were calculated using superposition in an infinite-acting reservoir, assuming no fluid withdrawal. The calculations also assumed a 30-year service life for project and an average injection rate of 12,000 bbls per day per well.

F. Potential impact of injection upon wells within area of review (i.e., due to pressure build-up):

None. There are no significant impacts within the area of review (see Theis calculation).

9. INJECTION WELL CONSTRUCTION

Four injection wells are proposed for the Hilmar Cheese Company project: Approximate locations for the wells are as follows (Attachment 1and Attachment 2):

Well No.	Latitude	Longitude	From N/S Line (ft)	From E/W Line (ft)
HCC-WD-1	37°25.144' N	120°51.253' W	75	1,585
HCC-WD-2	37°25.529' N	120°51.551' W	2,385	2,280
HCC-WD-3	37°25.146' N	120°51.810' W	75	1,025
HCC-WD-4	37°25.359' N	120°52.357' W	1,175	1,585

The proposed injection wells will be constructed after issuance of a final UIC permit for the facility. An area permit is requested for the four proposed Hilmar wells and may be granted at the discretion of the EPA Director.

Well construction information for all four wells is provided in a general form in this section. Well construction may vary depending on geologic conditions encountered at the location.

A. Schematic design:

See Attachment 12.

B. Deviation check and frequency:

None.

C. Casing program (including thickness, diameter, nominal weight, joint specifications, lengths, etc.):

See Attachment 12.

D. Cementing program (quantity, location, additives, grade, cement bond logging, etc.):

Injection casing to be cemented from top of proposed injection zone to surface.

E. Tubing:

See Attachment 12.

F. Packer (and other down-hole tools):

See Attachment 12.

G. Drilling/construction plan or well history:

The proposed drilling/construction plan for first injection well is provided below. See Supplement B of this permit application for the foamed-in slotted liner drilling/construction plan, which will be used on subsequent injection wells.

General Drilling/Construction Plan for First Injection Well

1. **Drill a 12-1/4" hole to ~800' using water-base drilling mud. Run and cement 9-5/8" 36# J-55 casing from 800' to surface.**
2. **Drill 8-3/4" hole to top of Paleocene-Cretaceous sands injection zone, estimated to occur at ~3,350'. Run and cement 7" 23# J-55 casing from 3,350' to surface. Change hole over to 8.4 ppg HEC polymer gel.**
3. **Drill 6-1/4" hole to top of Hall Shale, estimated to occur at about 4,150'. Circulate and condition hole, POOH.**
4. **Run triple combo log suite from 4,150' to 3,350' and obtain 10 sidewall cores (SWCs) from depths to be determined by log results.**
5. **Run ~800 ft of slotted (2" X 200M, 24R, 6"C) 5" 15# J-55 casing on bottom of Liner hanger with a 20' polished bore receptacle and ~30 ft of blank 5" 15# J-55 casing on top.**
6. **Land liner with TLH set @ ~3,300' and bailing shoe @ ~4,150'. Spot HCl acid breaker with corrosion inhibitor and clay stabilizer to clean up drilling damage. Overdisplace acid from wellbore with 200 bbls 2% KCl treated with clay stabilizer.**
7. **Run seal section on 5" tubing. Reverse circulate annular volume of water based packer fluid down casing-tubing annulus, stab seal into PBR and land tubing in ~15,000# compression. Install injection tree. Place well on injection.**

H. Well completion (screened, tubing and packer, perforated):

See Item G above.

I. Well stimulation (description of methods):

See Attachment 19.

J. Internal and external pressures, axial loading:

Assuming a top perforation at an average of 3,350 ft, bottom perforations at an average of 4,150 ft, and a maximum allowable injection gradient of 0.72 psi/ft; the maximum anticipated internal casing pressure at TD is calculated as follows:

Based on a current reservoir pressure of 1,507 psi at 3,350 ft, the maximum external casing pressure is expected to be 1,856 psi at ~4,150 ft.

10. LOGGING PROGRAM

Dual induction, SP, gamma ray, and neutron/density logs will be run at least through the confining and injection zones after the proposed wells are drilled to TD. A cement bond log will be run from the top of the injection zone to surface after the casing is cemented in place. Ten sidewall samples will be acquired from the first well to be drilled for laboratory analysis.

A. Pertaining to surface casing:

1. Before casing and cementing: resistivity, SP, gamma ray, neutron, caliper logs, etc.:

   See discussion at top of this section.

2. After casing and cementing: cement bond, temperature, gamma ray, neutron logs, etc.:

   See discussion at top of this section.

B. Pertaining to intermediate and long string casing

1. Before casing and cementing: resistivity, SP, gamma ray, porosity, density, sonic, caliper logs, etc.:

   See discussion at top of this section.

2. Fracture locating logs:

   See discussion at top of this section.

3. After casing and cementing: cement bond, temperature, gamma ray, neutron logs, etc.:

   See discussion at top of this section.

4. Approved alternative surveys (e.g., radioactive tracer, spinner, etc.):

   See discussion at top of this section.

C. Lithologic logs, mud logs:

   A mud log will be maintained on at least one of the proposed disposal wells.

D. A descriptive log interpretation report prepared by a knowledgeable log analyst:

   As necessary.

11. PLUGGING AND ABANDONMENT

A. Narrative description of cement plug placement (well in static equilibrium)

   Proposed injection wells will be abandoned in accordance with EPA, DOGGR, and other applicable requirements in force at the time that these wells are abandoned. Please refer to Attachment 20 for abandonment procedures, costs, and well schematics.

   1. Balance method:

   2. Dump bailer method:

   3. Approved alternate method:

B. Schematic diagrams (full detail):

   See Attachment 20.

C. Cementing program (type, quantity, grade, additives, and location of cement and drilling fluids):

   Cementing programs will comply with EPA, DOGGR, and other applicable requirements in force at the time wells are abandoned. As a minimum, a bottom cement plug shall be placed from ED extending to 100' above the liner top, a 200' cement plug shall also be centered across the base of fresh water, and a 100'

cement plug will be placed at the surface of the well. All cement plugs will use Class G cement with appropriate fluid loss and friction-reducing additives to achieve a minimum compressive strength of 1,600 psia at a 48-hour set. Wellbore spaces between cement plugs shall be filled with abandonment mud conforming to DOGGR and/or EPA requirements, whichever is more stringent.

12. MAPS AND OTHER EXHIBITS

A. Topographic map: USGS quadrangle sheet as base map. (Map should extend a minimum of one mile beyond the property boundaries.) At a minimum, the base map needs to illustrate the following:

1. Surface facilities:

See Attachment 1 and Attachment 21.

2. Project area:

See Attachment 1 through Attachment 3.

3. Public water supply facilities:

None using groundwater from the proposed injection zone.

B. Topographic map: Showing all wells in project area (same scale as above)

1. Well ID (name and number):

See Attachment 1 through Attachment 3 and Attachment 22.

2. Type (production, injection, irrigation, water supply, enhanced recovery, monitoring):

See Attachment 3 and Attachment 22.

C. Geologic map (same scale as above):

See Attachment 23.

D. Structural contour maps (mapped on top of injection and confining zones, both regional and site specific):

Structure contour maps on the top of the Paleocene-Cretaceous sands for the proposed injection zone and the Kreyenhagen shale for the confining zone are provided in Attachment 11 and Attachment 8, respectively.

E. Geologic cross-sections:

1. Geologic formations:

   Included on regional cross-sections (Attachment 4), project cross-sections (Attachment 9), and cross-sections through shallow aquifers (Attachment 24).

2. Structural features:

   Included on regional cross-sections (Attachment 4), project cross-sections (Attachment 9), and cross-sections through shallow aquifers (Attachment 24).

3. Shallow aquifers:

   Included on regional cross-sections (Attachment 4), project cross-sections (Attachment 9), and cross-sections through shallow aquifers (Attachment 24).

4. TDS levels for each formation, including sources of data:

   See TDS information on the type log for the project area (Attachment 5) and geologic cross-sections in Attachment 9. TDS data from shallow aquifers also are provided in Attachment 24.

5. Underground sources of drinking water:

   The base of fresh water in the project area is shown on the type log in Attachment 5, on geologic cross-sections in Attachment 9, and on the geologic diagram in Attachment 4B. A groundwater elevation map of the base of fresh water also is included in Attachment 25. Aquifers overlying the base of fresh water are assumed to be underground sources of drinking water (USDWs). Additional information on groundwater quality for shallow aquifers is included in geologic cross-sections in Attachment 24.

In the proposed injection zone within the area of review, TDS was calculated to be more than 10,000 mg/l, making the aquifer exempt as a USDW (Pacific Geotechnical Associates, 2004b; WELENCO, 1995). Review of well data in the project area indicates that groundwater in the proposed injection zone does not currently serve as an USDW and is not reasonably expected to supply a public water system in the future.

6. Injection zone:

   See Attachment 9 for geologic cross-sections.

F. Stratigraphic column (by formation)

   Stratigraphic information for the area is shown on the type log (Attachment 5).

1. Lithology:

   Sands and shales generally are indicated on a SP log by deflections to the left and right, respectively (Attachment 5).

2. Mineralogy:

   The mineralogy of the proposed confining and injection zones is discussed in Sections 4.D and 5.D of this permit application and generally indicated by log character on the type log (Attachment 5).

3. Physical features (texture, bedding, etc.):

   See log character on type log (Attachment 5).

4. Thickness:

   See thicknesses shown on the type log (Attachment 5).

5. Formation hydraulic conductivity or permeability:

   See resistivity and SP curves on the type log for permeability indicators (Attachment 5).

6. Porosity:

   See resistivity and SP curves on the type log for porosity indicators (Attachment 5).

7. Salinity profile (TDS):

   See annotations on type log (Attachment 5).

8. 10,000 mg/l and 3,000 mg/l TDS baseline (freshwater baseline):

   The base of fresh water and TDS information is shown Attachment 5.

9. Geologic time scale:

   See annotations on type log (Attachment 5).

G. Isopach maps (minimum one-mile radius from injection well)

1. Confining zone (total unit and net clay):

   See Attachment 6 for a map of the thickness of the Kreyenhagen shale. An isochore map of the E-Clay aquitard (Corcoran clay equivalent), a regional, shallow confining zone in the project area, also is provided in Attachment 6.

2. Injection zone (total unit and net sand):

   See Attachment 10 for an isochore map of the Paleocene-Cretaceous sands in the proposed injection zone.

H. Area of review (on topographic map showing proposed and existing well locations). Illustrate area(s) of influence as calculated by the following methods for both pressure front and waste front)

1. Quarter mile radius or area of influence, whichever is greater:

   See Attachment 1 and Attachment 2.

2. Pressure build-up method for both individual and multiple well operations.

   See Attachment 1 and Attachment 16.

3. Volumetric method.

   See Attachment 1 and Attachment 2.

4. Modeling output (if appropriate).

   Not applicable.

I. A map showing all wells within one-mile radius of the proposed injection well(s) that produce oil or gas from the injection zone and/or confining zone.

   See Attachment 1 through Attachment 3.

13. OPERATING DATA

A. Injection rate (average and maximum, in barrels per day and million gallons per day) and describe any daily or seasonal variations:

   The maximum anticipated injection rate is 12,000 barrels of water per day.

B. Injection pressure (average and maximum), injection pressure gradient at top of injection zone not to exceed 0.8 psi/foot without approval:

   Based on a top perforation depth of about 3,350 ft and a maximum allowable fracture gradient of 0.80 psi/ft, the maximum anticipated surface fracture

pressure is about 1,206 psia. Using a 10% safety factor, the surface injection pressure will be limited to 1,085 psi.

C. Annular fluid (type, volume, additives, pressure, density, specific gravity, etc.):

Fresh water treated with corrosion inhibition chemicals shall be used as annular fluid.

D. Results of injectivity testing:

None done to date.

E. Calculate hydrofracture pressure for zone and method used to derive pressure limit:

Please refer to Section 5.H.3 of this permit application.

14. MONITORING

A. Describe any proposed monitoring programs

1. Mechanical integrity monitoring and reporting program:

Well surveillance and mechanical integrity testing shall conform to EPA, DOGGR, and other applicable requirements in force throughout the life of the proposed injection wells.

2. Ground water monitoring program (if applicable):

Not applicable.

15. SURFACE TREATMENT FACILITIES

A. Process diagram (with descriptions of individual units):

See Attachment 21.

B. Narrative process description:

See Attachment 26 for a narrative description of Hilmar Cheese Company's wastewater treatment process.

C. Disposal of sludge and hazardous materials (if applicable):

Not applicable.

D. Effectiveness of pretreatment (removal efficiencies):

See Attachment 26 for a description of Hilmar Cheese Company's wastewater treatment process.

E. Hazards associated with precipitation and flooding, and any proposed mitigation methods:

Not applicable. Based on review of a flood hazard map from FloodSource Corp. (1999-2002), the project area is outside the 100-year floodplain.

16. FINANCIAL ASSURANCE

Financial assurance demonstration to indicate ability to maintain resources to close, plug, and abandon the injection operations in a manner consistent with the Underground Injection Control program regulations. (Include a detailed listing of cost estimates, and adjustment for inflation over life of project. California Division of Oil, Gas and Geothermal Resources bond values based on depth are inadequate.):

Financial assurance demonstration will be provided. Cost estimate for abandonment of proposed wells is included in Attachment 20.

Respectfully submitted,

Donna M. Thompson
California Registered Geologist No. 5347

REGISTERED GEOLOGIST
DONNA M. THOMPSON
No. 5347
STATE OF CALIFORNIA

CERTIFIED HYDROGEOLOGIST
DONNA M. THOMPSON
No. HG 241
STATE OF CALIFORNIA

17. REFERENCES

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